SCIENCE:

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CORN CANE.*

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MUCH attention was given to the physiological affinities of maize to discover, if possible, whether in the case of any other of the solid-stemmed grasses with which it naturally ranks, a similar correlation exists between seed development and the accumulation of reserve materials in the culm, with cane sugar as the principal ultimate product.

In this connection, it became a point of especial interest to determine what the deportment of sugar cane and sorghum would be under like conditions, and accordingly the investigation was extended to them, along the same lines.

It was soon found that a comparatively new field had been entered upon and that no progress could be made without constant appeal to the microscope and approved methods of chemical analysis for the correct determination of many important questions requiring solution. Thus, some safeguard was established to prevent false analogies from being followed and false conclusions reached, such as have marked and marred the whole rationale of treatment, both of the beet and of sorghum, in the attempt to make sugar manufacture from them practicable in this country.

It was found to be the fact, uniformly, that from the time the sugar first shows itself in the cell sap, during the early growth of maize, until the grain begins to harden, it steadily increases. But what is most remarkable is that it then suddenly diminishes and disappears, leaving behind it scarce a trace of its former presence. Other allied plants, such as sorghum, up to a certain period of growth, manifest the same characteristics, but beyond that the resemblance ends. Sorghum does not reach its full saccharine strength until its seed is dead ripe. Maize, on the contrary, if its grain be allowed to pass into that condition, parts with its sugar utterly, but if the offered alternative be taken and the ear be removed promptly at the critical period, all the vital energies of the plant become at once directed to the special work of storing up highly organized food materials in the cells of the stalk. Instead of dying, off hand, as it does in the other case, the plant *lives on,* and without a break the constructive forces go on converting the simpler into the more complex reserve materials. The stalk is their storehouse, and, under the new conditions imposed, that part of the plant passes through a supplementary stage of development. Its principal function then is to accumulate sugar.

It would be out of place, in a brief sketch, to particularize the changes then occurring, further than to say that the other carbohydrates, generally, give place to sugar. There is also a sensible increase of the protein substances keeping pace with the increase of the sugar.

It is then a process of *juice ripening,* borrowing the term from an analogous process which is carried on in the maturing joints of the sugar cane. This led to a closer comparison of the latter with Indian corn when in this anomalous condition. Living ribbon cane from Louisiana, received here fully matured and in perfectly good condition, and young joints at hand growing under glass, furnished ready means of comparing them closely under all ordinary conditions of growth and development. It is very evident that the two species have then several characteristics in common which are not evident when the cane is compared with corn in what we call its natural condition. The following have especial significance, as they approach maturity.

1. In both plants the solid stalk or culm has then become simply a reservoir of materials available for plant food, and in the case of the sugar cane, made use of when active growth by the joints begins.

2. In both, the development of the organized products is progressive, *i. e.,* from the more simple to the more complex of the series, which take the soluble form and are available for transmission to any points where new organized structure is to be built up.

3. By reason of the constant accumulation of these soluble materials, chiefly, the weight of the plant and the density of the juice increase.

4. The general plan of structure and physiological properties of the stem in both are very much alike, although there are very striking differences, and they become more alike, both in structure and function, as this period advances, the separate joints of the one and the whole stalk of the other attaining their full size before the highest elaboration of their juices takes place.

5. It is a well-attested fact that ordinarily no variety of sugar cane is known to perfect its seed or, to use the language of May, "to produce anything like seed, either in India, China, the Straits of Malacca, Egypt or the South Sea Islands." By a curious analogy maize, in this secondary stage of development, is likewise incapable of producing seed, having lost, apparently, its capacity in that direction.

There are other points of resemblance which it would be interesting to note, but that to which the most importance attaches in this connection is the highly saccharine condition of the juice in both, which ranks them together more closely than their striking natural relationship otherwise would seem to justify.

The reader is referred to the table in which the average sugar percentage of both is given as based upon the most recent and reliable analysis. It will be seen, I think, that the term *corn cane* has not unreasonably been applied to a plant which in a summer's growth can thus be made to develop qualities which give it a rank second only to the tropical cane.

Also, it will be observed that the saccharine qualities of the juice, only, have been compared in the table.

But, as between the other sugar-producing plants named and Indian corn there can be no further comparison. Maize is a cereal of the highest value, and it does not lose that character in this case. The high *condition of sugar development which it can now be made to attain is not attended by the sacrifice of the grain,* and against this grain product neither the sugar cane nor the beet can show any compensating value whatever.

This fact cannot be discounted by the assumed inferi-

*Continued from Science, Sept. 15.

ority of the corn grain when harvested at the time at which it is necessary to arrest its development to secure the sugar crop. Fifty years ago it might have been necessary to argue that point, but within that time the corn canning and drying industry has arisen, and immense quantities of American "sugar" corn are now put upon the markets both of this country and of the old world in response to the demand for the immature grain, and within the last decade the same product from "field" corn, along with the green fodder, cured by the ensilage system, has won an established value as the best form, the most nutritive and most readily preserved without loss, in which the whole plant can be utilized for stock feeding.

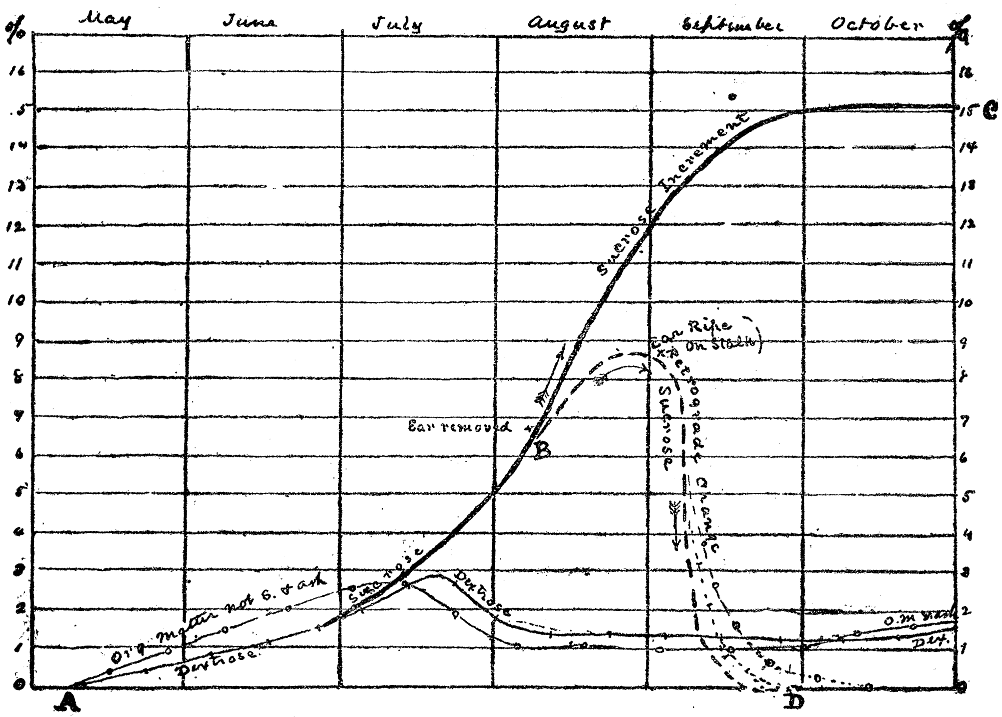
This plant is capable, then, of yielding its grain in one of two widely different conditions, as widely different in fact as if they were the product of two different species. Ripeness may be affirmed of either, if by that is meant, first, the possession by the grain of germinative power, for both will grow, and, second, a developed condition of the nutritive elements far enough advanced in the grain at either stage to fit it in the best manner for certain special uses as food.

We can have either condition of the grain at will, and our ability to secure either gives us a variety in the choice of food from this single source not approached by the products of any other plant. We have the option between two series of food products widely different, derived simply from one kind of grain taken in two different and successive stages of development.

We elect to take it at the earlier stage, when we propose to produce sugar, and our taking it then is the one condition upon which the proper juice-ripening in the cells of the stalk depends. Two crops are thus secured from the same plant, instead of one, the interval between the maturing stages of each being long enough to enable both to be properly cared for without loss.

It does not detract from the value of our ordinary field corn in this connection that its immature grain cannot be used to the same advantage for canning or drying as that of the so-called sweet varieties. The peculiar softness and sweetness of the grain of the latter has practically nothing to do with the amount or quality of the saccharine secretion in the cells of the other parts of the plant. In fact, the plants with the richest juice are the tug-stemmed field sorts; the dwarfage of the varieties grown by the truck gardener and for canning comes from selection to produce extra early ripening, and the small size of most of these will exclude them from use where sugar manufacture is the object.

But the grain of field corn taken in this connection will serve its highest purpose for stock feeding. As will presently be shown, it has a distinct and superior value to the hard, full-ripened corn, for this purpose. Systematic experiments made within the past few years at different state agricultural stations in this country, and by practical farmers, stock growers and dairymen, not only prove this conclusively, but indicate beyond question what is the best means of curing and preparing it for use as animal food. I refer to the ensilage system, in the practice of which Indian corn is almost exclusively used.



DIAGRAM,

showing approximately the composition of the solids in the juice (sucrose, dextrose and organic matter not sugar and ash) during the life of the plant.—A. B. C. from planting to final ripening of juice.—A. B. D. from planting to full ripening of grain.

As is well known, wherever it is grown for this purpose to the most advantage the aim is to secure the most luxuriant growth, and the fullest development of the whole plant up to the time when the grain is fully formed, but still soft. Under such circumstances the ear composes a large proportion of the prepared silage, twenty-five to thirty-five per cent.

It is no part of my present purpose to discuss a point which just here demands special notice, namely, the richer quality and higher value of corn silage attainable by modifying the system so as to take advantage of the full development of the food materials within the plant, upon which, as already shown, its value in sugar produc-

tion entirely depends by harvesting and pitting the ears at the usual time, and the fodder at a *later* period. As shown (in the table) there is a large increase of the substances containing nitrogen, as well as the carbohydrates under the new conditions. The special bearing which this, as well as other facts which cannot here be particularized, must have in modifying the existing system of stock feeding, either by ensilage or dry fodder, is hardly second in importance to its relations to sugar production.

Also, it should be noted in this connection that it is now found that corn fodder, cut after the last stage of the ripening of the grain has been reached, is subject to great loss of nutritive matter.‡ The destruction and disappearance of the soluble carbohydrates follow in that case as inevitably as their preservation and increase do after the removal or arrested development of the ear.

Except the trimmed stem, every other part of the plant will go to the silo, when sugar production is the object, and the resulting food products will be as much richer than ordinary ensilage in all the elements of nutrition as the larger proportion of the grain to the whole mass, and the more highly elaborated juices of the tops and leaves enter into it.

(To be continued.)

NATURE AND DISTRIBUTION OF NEW YORK INDIAN RELICS.

BY W. M. BEAUCHAMP, BALDWINSVILLE, N. Y.

While Indian relics are almost unknown in some parts of New York, in others they are abundant. Forts, villages and camps are often found far away from lakes and rivers, for security from enemies was an important consideration, and when villages were established there was often regard to the fertility of the soil. As this and fuel failed, removal become necessary, but almost invariably the red man of New York placed his lodge on sandy ground. In a general way, however, the relic hunter will seek the banks of rivers and streams, especially at fords and rifts, with the best hopes of success. Hunters, fishermen, and traders have there left the finest articles.

He will soon learn that all sites are not alike, some noticeable things rarely, if ever, appearing with certain others. By close examination and comparison he may sometimes establish a sequence of sites, or discover relations between those far apart. He will be blind indeed if he does not soon see plain evidences of aboriginal travel and trade. He will learn one curious fact, that, in the larger part of the Empire State, the finest stone implements are among the oldest. With ample material for illustration before me, this paper will simply deal with the character and distribution of Indian articles in New York.

Chipped Implements.—Arrows, spears, knives, perforators, scrapers, and other articles, are quite generally found, and of all the usual kinds. A drab-colored hornstone is the most common material, but there is a great variety of others. All colors of jasper will be seen among these, with quartz, chalcedony, argillite, limestone and sandstone. White arrows are more prevalent in the eastern part than in the west, and some sites afford local and unique forms. Although hornstone is abundant in the long Helderberg range, much of the material was brought from a distance, and cores and chips occur abundantly far from the quarries. Caches of unfinished implements are frequently found, usually of one form and size, and between two and three inches long. I know of no form of arrow, knife, or spear ever described, which I have not figured from local specimens. Some are unique. Three of my arrows, above the notch, have the outline of the gable end of a house, with perfectly straight edges. Some triangular forms are almost as slender as a flint perforator.

Scrapers occur in great variety, and of as varied finish, but they are lacking in many places, as the Iroquis and some others did not use the stone scraper and drill. Neither need be looked for within earthworks and stockades. The leaf shape, combining the knife and scraper, is common. Mr. A. G. Richmond found scrapers with serrated edges at a fishing camp on the Mohawk. They were small and rare. I have found other forms from small to large sizes. Sometimes they are curious. One, of green jasper, long and nearly triangular, has a knob at the top, as though for suspension, and projecting points on either side of the broad base. Another rare form is sabre-shaped, the concave side being the scraper, and the convex, a knife. Flint perforators are often very fine, and vary from the simplest forms to those quite complex. Some are of very great interest. Flint hammers occur, and some very small flint disks a friend has called gambling flints. Rarely a hornstone celt has been slightly ground, but rude celts of sandstone are often chipped.

The flat sinkers, or quoits, are also chipped implements. They are sometimes quite large, and found near water,—sometimes in it. Usually they are between a rectangle and circle, often with notches on the four edges. I have found them, however, miles away from any fishing place, aud think they were often used in games. The smallest form I have resembling these, is polished, circular, about an inch across, and with two notches cut on opposite edges. Larger oval pebbles are found grooved for anchors. About Cayuga and Seneca Lakes, smaller grooved pebbles are abundant, about the size and form of a hen's egg.

Hammer stones, so called, are of endless forms, and of many uses. Like the preceding, they were in use quite recently. I have seen one on which a figure was inscribed with compasses. They may have one or more pits on one or both sides, or on every face on which there is room. The edges are not always hammered, and sometimes circular ones have been changed into chungke stones.

The grooved stones, used by the Iroquis about the beginning of the seventeenth century, are peculiar to their territory, thus far appearing in that of the Mohawks, Onondagas and Senecas. They are bowlders, in which appear one or more wide, straight and uniform grooves, finely striated from end to end, and are supposed to have been used in arrow making. This may possibly have been.

Occasionally finely polished pestles appear, but most of those along the Seneca River are merely long pebbles, showing use, and sometimes polished. Generally they are slightly chipped, and sometimes squared. Rarely a pit is made near one end. The Iroquis used, and still use the wooden pestle with double ends.

‡This is an invariable result, and it sufficiently reveals, I think, the source of the hitherto unaccountable loss of solids reported as occurring during the curing of corn fodder.

About three years ago Prof. W. A. Henry, of the Wisconsin Experiment Station, called attention to the results of tests made there to determine the amount of dry matter in green and dry corn fodder; which showed that the cured fodder lost not less than twenty per cent. of its dry substance before it was fed out as compared with the dry matter in the same fodder when it was cut down green in the field. The fact of the loss was well attested; but it was practically discredited because no sufficient cause could be assigned for it.

But in 1881 Prof. Geo. A. Cook, of New Jersey, had noticed a loss of dry substance in corn fodder under similar circumstances, and that the loss fell almost entirely upon the soluble carbohydrates. (N. J. Expt. Sta. Report for 1882.)

Prof. E. H. Farrington, of the Illinois Station, records a decrease, not definitely accounted for, of 17.3 per cent of dry matter in the whole plant cut and analyzed two weeks after the ripening of the grain. ("Science" April 15, 1892, p. 212.)